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A planar structural element made from metal, particularly for filtration, and a method for producing a planar structural element and for using such a planar structural element.

The invention relates to a planar structural element made from metal, particularly for filtration, and a method for producing a planar structural element and for using such a planar structural element.

Planar structural elements made from metal cloth are used mainly for filtration and in conveyor belts. In both applications, the cloth is required to have a particularly fine surface and high stability. The difficulty in both cases is that particularly fine wires must be used to achieve a particularly small pore size, but the fine metal cloths produced therewith are not highly robust.

In order to achieve adequate stability of the planar structural element despite this, fine filter layers are attached to a coarser support layer. In this way, it is possible to combine a high degree of stability of the filter cloth with an extremely fine pore size distribution.

However, the disadvantage of such cloths has been shown to be that the surface pores easily become clogged, with the result that the sieving function is impaired.

This problem may be solved by making the change from surface filtration to depth filtration. For this, multiple fine filter cloth layers are placed on top of one another so that the particles are trapped at different distances as they pass through the layers of fine cloth. This means that sieves may remain in service for longer because the sieve is not clogged until all the sieving layers are blocked.

However, the manufacture of such sieves, consisting of multiple layers of fine cloth, involves much effort, since multiple layers of cloth must be manufactured and bonded together.

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A less expensive manufacturing process of a sieve suitable for depth filtration provides for metal filaments to be thermally sintered on a wire mesh before the planar structural element is rolled. A planar structural element suitable for depth filtration is produced by this method also, however this has the disadvantage that the filaments cannot be joined in absolutely homogeneous manner, which causes fluctuations in the density distribution. As a result, the sieve cannot be aligned optimally, which in turn leads to compromises in determining the maximum pore size and filter area available for use.

Sintered planar structural elements have the further disadvantage that they must be heated in furnaces, and these furnaces only have special dimensions. For example, standard furnaces have a width of 600 mm or 1200 mm and are therefore too small for the production of widths of 3000 mm. Consequently, in practice multiple panels are welded together. The result of this, however, is the loss of usable filter area and unevennesses on the surface of the planar structural element.

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The object of the invention is therefore to improve a planar structural element, particularly for filtration, such that optimal filtration results can be obtained with a planar structural element that is inexpensive to produce. This object is solved in that a metal fibre thread is introduced between metal wire.

The term metal fibre thread is used to describe a filamentous product prepared by spinning fibres. The fibres used in this process may be a bundle of extremely long spun

fibres. However, they may also be broken off or cut short and twisted into a thread. Metal fibre threads are preferably made from many twisted fibres, and an extremely wide variety of threads can be produced depending on the diameter of the fibres, length of fibres and type of twisting or subsequent treatment of the thread.

On the other hand, the term metal wire is used to describe a wire that is produced from bars by wire drawing or rolling.

The combined effect of metal wire and metal fibre thread has the great advantage that the metal fibre thread disposed between the metal wire is in a protected situation so that it can, for example, perform the function of depth filtration. However, the planar structural element also has special acoustic properties and high flexibility, which render it suitable for use in a very wide range of applications.

When the planar structural element according to the invention is used for filtration, the metal fibre thread serves as the filtering element for depth filtration, while the metal wire protects the metal fibre thread from mechanical impairments and improves drainage of the metal fibres. The wire is in contact with the metal fibre thread, and thus improves the wicking of liquid from the thread to provide optimum drainage.

It is advantageous if the metal fibre thread has a larger diameter than the metal wire. The effect of depth filtration, for example, may be improved for filtration by increasing the proportion of thread, whereas a metal wire of smaller diameter is sufficient to fulfil the functions of drainage and protection.

The planar structural element may take the form of a braid, netting, or similar. A simple configuration is produced by weaving the metal wire together with the metal fibre thread. In this way a cloth is obtained that combines the advantages of a wire fabric with those of the metal fibre thread tissue.

It has proven particularly advantageous for the production of such cloths if the metal wire constitutes the warp and the metal fibre thread the weft of the cloth. In this way, the metal fibre thread is arranged in protected manner in the cloth, and ideally has no crease marks, which may cause the thread in part to be excessively compressed.

Good experimental results were achieved by using a monofilament wire as the metal wire. The monofilament wire is easily worked and is particularly well suited for drainage of the planar structural element.

It is advantageous if the planar structural element is conformed so that the metal wire lends a smooth surface to the planar structural element. This smooth surface can be cleaned simply by mechanical means and allows a planar structural element to be produced with low layer thickness.

Depending on the application, it may be the case that the planar structural element described is not sufficiently robust. In such event, it is suggested that the planar structural element be provided with a support layer of metal wire, preferably monofilament wire. This support layer, which is preferably applied to one side of the cloth, may for filtration purposes be coarse enough to allow the filtrate to pass unhindered through the support layer. However, a very wide range of support layer types is possible depending on the application.

Particularly when a support layer is used, it is suggested that the planar structural element be held together by a metal wire, preferably a monofilament wire. This wire should be worked into the planar structural element in such manner that the surface of the planar structural element remains smooth.

A preferred embodiment provides that a section through the metal fibre thread consists of more than 100, preferably more than 500 individual capillaries, a single capillary having a diameter less than 100 μm and preferably less than 30 μm.

The object according to the invention is also solved by a method for producing a planar structural element, in which a metal fibre thread encased in a skin is woven into a cloth with a metal wire and the skin is subsequently removed.

It has been shown that metal fibre threads are not easily woven, and there is a danger that they may be damaged during the weaving operation. It is further proposed according to the invention, therefore, that the metal fibre thread be encased in a skin before weaving, and that this skin be removed when the weaving operation is complete. The skin holds the individual fibres of the thread together and provides a smooth surface, which facilitates weaving.

One variant of the method provides for the removal of the skin with the aid of a liquid. For example, paraffin may be used as the skin, and my be rinsed off with warm water at a temperature of 60 °C.

Since the planar structural element according to the invention is made entirely from metal, it is easily weldable, and so it is proposed to weld the tissue to a

solid body. In this way, conical filtering surfaces, filter discs or any other filtration bodies may be produced.

The use of stainless steel for the metal fibre thread and the metal wire is especially proposed for applications in the food industry.

A particularly preferred field of use for the planar structural element of the invention is depth filtration.

The drawing illustrates a preferred embodiment of the invention, which is described in detail in the following. In the drawing:

Fig. 1 is a view of a lateral surface of the planar structural element,

Fig. 2 is a bottom view of the planar structural element,

Fig. 3 is a view of the opposite side of the planar structural element,

Fig.4 is another view of the planar structural element, and

Fig. 5 is an enlarged section of the view in Fig. 3.

Planar structural element 1 shown in the figures consists of a multiplicity of metal wires 2, 3, 4, which are woven together with a metal fibre thread 5, the monofilament metal wires 2, 3, 4 forming the warp, and the metal fibre thread forming the weft. By way of example, Fig. 3 clearly shows the distance at which multiple metal fibre thread strands 5, 6, 7, 8, 9, 10, 11, 12 are arranged with respect to one another, and the monofilament metal wires, for example monofilament metal wire 3, pass alternately over two metal fibre threads, 6, 7, and then under two metal fibre threads, 8, 9. Since the adjacent metal wire 4 follows the pattern at a remove of one metal fibre thread 6, first passing over two metal fibre threads 7 and 8, and

then under two metal fibre threads 9 and 10, the separation between the metal fibre threads is maintained by the interposed metal wires.

Metal fibre threads 5, 6, 7, 8, 9, 10, 11, 12 arranged in parallel form a plane, and the surfaces of metal wires 2, 3, 4 form parallel surfaces 13 and 14 above and below this plane.

Upper surface 13 is particularly smooth so that it may be cleaned easily, and lower surface 14 serves for the application of a support layer 15. Support layer 15 itself consists of a cloth made from metal wires 16, 17, 18, 19, which is arranged below the cloth layer described previously and is composed of metal wires 16 to 19 having a larger diameter than metal wires 2, 3, 4 described previously.

In the example shown, the cloth consisting of metal wires 2, 3, 4 and metal fibre thread 5 to 12 forms filtration layer 20, and the cloth with the thicker metal wires 16 to 19 forms protective layer 15. Protective layer 15 is attached to filter layer 20 by relatively thin metal wires 21, 22.

The cooperative relationship between metal wires 2 to 4 and metal fibre thread 5 to 12 in creating a solid structure is revealed in Figs. 2 to 5, and particularly in a consideration of all Figs. together. The exact path of the individual wires, which is an essential element of the invention, will be clear to one versed in the art.

The Figs represent an enlargement of the cloth. In particular, Fig. 5 shows that metal fibre thread 5 consists of metal fibre thread strand made up of many individual capillaries 23.

Metal fibre thread strand 5 is disposed between monofilament metal wires 2, 3 and 4 of the warp and completely fills the cavities formed by the warp. This is clearly shown in the eye-shaped section of metal fibre thread strand 5 in Fig. 5.

In practice, the tissue is designed for a filter mesh of about 1 μm to 200 μm.

The metal fibre threads used are made up of more than 500 individual capillaries each having a diameter less than 30 μm, and the fineness of this material means that the thread may easily be damaged during weaving. Therefore, each fibre is first coated with a film of paraffin prior to weaving. The paraffin film eases the weaving operation and protects the tissue. The paraffin film may be rinsed off subsequently with warm water at a temperature of 60 °C, so that the filtration properties of the metal fibre thread are restored.

The planar structural element produced in this manner is then usually welded to create filter discs or other filter elements depending on the application. The availability of particularly wide looms for working metal wires enables the production of cloth widths several metres wide, which are suited to an extremely wide range of applications.